

November 20, 2002

Tomorrow's Energy

by Michael J. Manzi

As anyone who pays attention to these things knows, time is running out for our society to free itself from dependence on fossil fuels. The world's reserves of oil, coal and natural gas are running out. Estimated timetables range from 50 to 200 years. More eminent are the costs of securing access to this fuel and the real threat of global warming. The immediate problem, however, is pollution. In the United States, about 30,000 premature deaths a year are attributed to power plant pollution.¹ Anyone who bicycles, jogs or walks along busy roads understands, without all the facts, what our over-dependence on inefficient automobiles is doing to the atmosphere. Now consider that all of our energy needs can be met with current technology and without any of the problems listed above. Hydrogen, the lightest and most abundant element in the universe, has the potential to provide emissions-free energy to serve all our needs indefinitely.

Energy from hydrogen is derived in two basic ways. Hydrogen can be burned like gasoline or combined with oxygen in a fuel cell to produce electricity. Both methods have been used extensively in the space program. Fuel cells were an essential element in the moon landing missions, as they efficiently provided power and clean water, the only byproduct besides heat.²

Basically, a fuel cell works when hydrogen and oxygen are introduced on either side of a proton-exchange membrane. Hydrogen ions, or protons, pass through the membrane to combine with the oxygen, forming water. The electrons, because they cannot pass through the same membrane, speed through wiring outside the cell in the form of an electrical current.³

Other hydrogen-containing compounds are used with oxygen in fuel cells, but only pure hydrogen fuel cells are emissions-free. In fact, hydrogen does not regularly exist in pure form, and energy is required to extract it from a source. Currently the most economical means utilize fossil fuels, meaning the system is not emissions-free. However, the simplest way to get hydrogen is through electrolysis, running a current through water. If this current is generated using renewable energy such as solar or wind power, a completely emissions-free system exists.

The automobile industry and United States military have recognized the potential of hydrogen. Prototype cars have been tested that burn hydrogen directly and that use fuel cells. Within the next few years, both will be available to the public. The military is developing forward deployed generator systems that utilize fuel cells and provide benefits including high efficiency, low emissions, low infrared signature and low noise levels. Also, over the last couple of years the military has been in the process of testing power generation via fuel cells at its various installations.⁴

The Long Island Power Authority is already producing power with fuel cells and transmitting the electricity over the existing grid. The short-term goal is 400 megawatt-hours a year with 75 fuel cell systems. The Conde Nast Building at Four Times Square gets supplemental power from a fuel cell. Plans are being finalized for a residence in Scottsdale, Arizona that will produce hydrogen using photovoltaic panels and use it to

power two family cars, the stove, water heater and a fuel cell generator. The home will produce more electricity than it will need, and sell the excess to the utility company.⁶

Even the oil companies see the promising future of hydrogen power. Shell Hydrogen was established in 1999 by the same conglomerate that owns Shell Gas stations. The company believes that hydrocarbon based fuel cell cars will be market competitive by 2008 and that pure hydrogen fuel cell cars will see mainstream use as early as 2016.³

Some of the challenges to be overcome include cost effective, emissions-free production of hydrogen, distribution, storage and safety. As mentioned, non-polluting methods such as solar or wind power can generate the current needed to separate water into hydrogen and oxygen. The present demand for photovoltaic panels and wind turbines is relatively low compared to fossil fuels, so the costs are much higher. When you consider the immeasurable cost to society of obtaining and burning fossil fuels, however, the difference seems insignificant. In the near term, distribution of hydrogen will be achieved using the same systems used today for natural gas and gasoline - pipelines and tankers. In the future, hydrogen will be produced nearly anywhere it is needed. Technology continues to improve the methods of storing hydrogen. Special considerations must be taken due to its instability as a stand-alone element and its explosive potential. Yet, results of a study done on behalf of Ford Motor Company conclude that hydrogen is at least as safe as other common fuels.⁷ In fact, because of its properties, it very quickly dissipates if accidentally released in an open environment, unlike heavier fuels.

Perhaps the biggest barriers to a hydrogen energy society are political will and public awareness. The current administration, to no-one's surprise, is bent on expanding the use of fossil fuels, especially oil. Most people seem content with the current cost and availability of petroleum and unaware or indifferent to the environmental consequences. A study printed in a recent edition of the journal Science concluded that a major push towards research and development of alternative fuels is needed to avert looming climatic disaster. The 18 scientists and engineers who conducted the study found that producing hydrogen using solar or wind power is currently cost prohibitive.⁸

Europe, however, is planning to spend billions of dollars in the next few years on research into hydrogen, determined to invent this new energy system.⁹ Some states, like California, have enacted legislation that will soon require emissions free automobiles. Federal, state and local governments are increasingly offering incentives for choosing alternative energies. Hydrogen is a great complement to the most common alternatives. Using solar or wind power to produce hydrogen solves the major problem with those sources. Namely, what to do when there is no sun or wind. Hydrogen becomes the energy storage mechanism.

All of these things will drive the cost of renewable resources down through increased demand. Some market research firms predict that by 2005, the electricity generating fuel cell market could be three billion dollars, and that by 2011, the market for on-site fuel cell generators could be ten billion dollars.⁵ An excellent investment opportunity exists, both in the future of our environment and quality of life, and in a market very likely to soon explode.

Works Cited:

¹Jeffords, Hon. Sen. James M. "The Clean Air Challenge." National Parks Nov./Dec. 2002: 16.

²Kranz, Gene. Failure is Not an Option. New York: Simon & Schuster, 2000.

³Shell Hydrogen - Welcoming the Hydrogen Economy. Retrieved November 1, 2002, from <http://www.shell.com/hydrogen-en>.

⁴Department of Defense Fuel Cell Research and Development. Retrieved November 1, 2002, from <http://www.dodfuelcell.com>.

⁵Silverstein, Ken. Fuel Cells: Generating Enthusiasm, July 12, 2002. Retrieved from <http://www.secure.scientech.com>.

⁶Beaulieu, Bryan. "Hydrogen House." October 5, 2002. Green Building Expo: Phoenix, Arizona.

⁷Barbir, Frano. Safety issues of hydrogen in vehicles. Retrieved November 1, 2002, from [http://www.iahe.org/hydrogen safety issues.htm](http://www.iahe.org/hydrogen%20safety%20issues.htm).

⁸Recer, Paul. Study Fuels Debate Over Energy Options. Associated Press, October 31, 2002. Retrieved from unknown website.

⁹Europe Sees Hydrogen Future. Associated Press and Reuters. Retrieved November 1, 2002, from unknown website.

Other Sources:

Siblerud, Robert. Our Future is Hydrogen! Energy, Environment, and Economy. Wellington, Colorado: New Science Publications, 2001.
(This book provided most of the background knowledge)

<http://www.google.com> (extremely helpful search engine).

<http://www.crest.org/hydrogen/index.html> (links to other hydrogen sites).